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The Sensing of Competence
Architecture and Functioning of a Plotting Device

Bernhard Bierschenk

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Abstract

Stimulated by the general philosophical idea of logical positivism Edgar A. Singer, early in the 1920s made the radical suggestion that behaviour does not have mental causes. His thesis, further developed and modified by Arturo Rosenblueth, Norbert Wiener and Julian Bigelow in the early 1940s, has come to be termed behavioural teleology. The principal motivation for Gerd Sommerhoff was in the beginnings of the 1950s to disjoin the behavioural approach from all notions of mind, mental states and mental representation. The aim was exclusively the study externally observable stimulus-response behaviour patterns. The present report concentrates solely upon the teleological study of behaviour and is the final contribution to the study of behaviour from a mechanistic point of view. Each of the integrated studies has been designed with the purpose to achieve a demonstrative definition of environmental conditions in the simulation of event-action pairs. In particular, the rigorous behaviour position taken in the definition of the concept of "competence" is the result of an application of a "targeted system analysis" as proposed by Sommerhoff in the beginning of 1990. Hence the presented approach has neither a need for the identification of deficiencies nor any use of McClelland's concept of "competence", which was based on Murray's "need for achievement" of the 1930s. To overcome obstacles, to exercise power, to strive to do something difficult as well as quickly as possible was Murray's definition of achievement. But, the definition in the present article differs from a formal point of view as well as content-wise from this kind of logical and psychological behaviourism. The most characteristic features of the developed approach relate to the operating variables, because these are reflecting the experimentally established functions of competition and success within formally defined limits of perception and action. Both are referring to estimates of "appropriate adaptation", which corresponds to the expression of the distinctive character of citizenship. The cities of Lund in the South of Sweden, Copenhagen in Denmark, and Singapore in the South of East Asia have been chosen for a description of possible differences concerning the (1) demarcation of perceptual competence and (2) appropriateness in a behavioural response. Both types of differences are indexed as achieved competence.

Introduction

Human experience requires the processing of information in harmony with structural and functional criteria. In a long series of experimental studies, conducted by the present author, it has been assumed that the processing of structural cues is system specific. From a functional point of view, it was postulated that a behavioural effect is the result of a causal pattern of physical events in the brain. But complementary processing of environmental information has also been conceived of as functional and a further criterion of import. Taken together, this meant that the organism as natural system could be "seen" as a system that becomes structured by a flow of energy through its own internal processes. Hence, behaviour would arise out of kinematic interactions and become principled by environmental constraints. Against this background, the present article may be conceived of as the finishing of an ecologically oriented approach to the modelling of "goal-directed" behaviour. Whether and to what degree the present author has been successful in adjusting "event perception and action" according to Gibson's (1979) formulation to the mechanistic point of view of the majority of psychologists will be demonstrated in the following. However, to speak with Sommerhoff (1968), the objective and experimental approach of the executed studies has made it possible to demonstrate that an action can be carried out "goal-directed" even though the executive subject is consciously unaware of its action.

Many characteristics of "goal-directed" behaviour are not readily related to one another nor is it clear how any mental endowment may influence the perception of environmental circumstances. There seems to persist a general agreement among psychologists, namely that individuals differ greatly in perceptual sensitivity and behavioural tendency when confronted with certain environmental conditions. This kind of differences has been related to mental constructs, which are assumed to mediate (1) physical and emotional suffering, (2) satisfaction of instincts, (3) reduction of deficits concerning certain drives, (4) construction of beliefs and attitudes, and even (5) the development of traits (White, 1959). All are conceived of as time-independent and consequently non-related to growth. Since L. J. Crombach and L. Furby (1970) asked the question: "How we should measure change - or should we?" it is obvious that the uniqueness of these concepts is related to their treatment. For example, compared to the study of vision and touch or taste, the constructs of behaviour are treated as state-determined and intermediary variables. They are subjectively fabricated and associated with concealed subjectivity and purposiveness.

Among those who foremost have contributed with behavioural studies and the discussion of variations in societal conditions are Boulding (1985), who has produced a volume on "Human Betterment" and Cantril (1965), who has explored "The Pattern of Human Concerns" as well as McClelland (1961), who investigated "The achieving society". Initially their concepts and constructs were used with the aspiration to establish an empirical frame of reference for experiments with the "Projections for the Future" (Lee & Mayer, 1976). Hence, the aim was to relate the extracted concepts to certain concrete circumstance in existent as well as projected society. It follows that concepts like exchange of matter, energy and information were expected to be of significance for the establishment of constructs like (1) "Physical Existence", (2) "Social Security", (3) "Freedom of Action", (4) "Effectiveness" and (5) "Adaptability". But, as a rule, it was necessary to extract more definitely formulated concepts, which could be taken to describe (1) social, (2) cultural and (3) physical conditions, and could be tested with respect to their semantic and pragmatic contents. The extent to which the individual's mechanism of "justification" and "social conformity" would "cancel" rationality of perceptual judgement and decision making was one important aspect in testing their usefulness. But, as a result of extensive testing, most of the variables obtained through the excerpts have been shown to be unrelated and trivial or incapable of use in dealing with any real or simulated situation.

The analytical approaches of Maslow (1954) and McClelland (1961) along with Cantril (1965) were of limited value. Especially Maslow's motivational approach was made the point of reference in an initial attempt to construct items during a doctoral course with students of economics. His hierarchical theory of human motivation, resulted in a meagre outcome. Therefore an extra-ordinary, i.e., a synthetic approach, was taken with the hope to be able to establish the "quality" (Q) property of a particular environmental milieu (B. Bierschenk, 1990). In short, (Q) could be transformed into a principal component (FI) of measurement. This (FI) was named *"Eigenvalue"*, because through this component becomes visible the determining weight a person carries. The other principal component (FII) established during the construction of measurement was "Visibility". The condition that is determining the standing of a person in the social order of his society has led to the name *"Visibility of Social Texture"*.

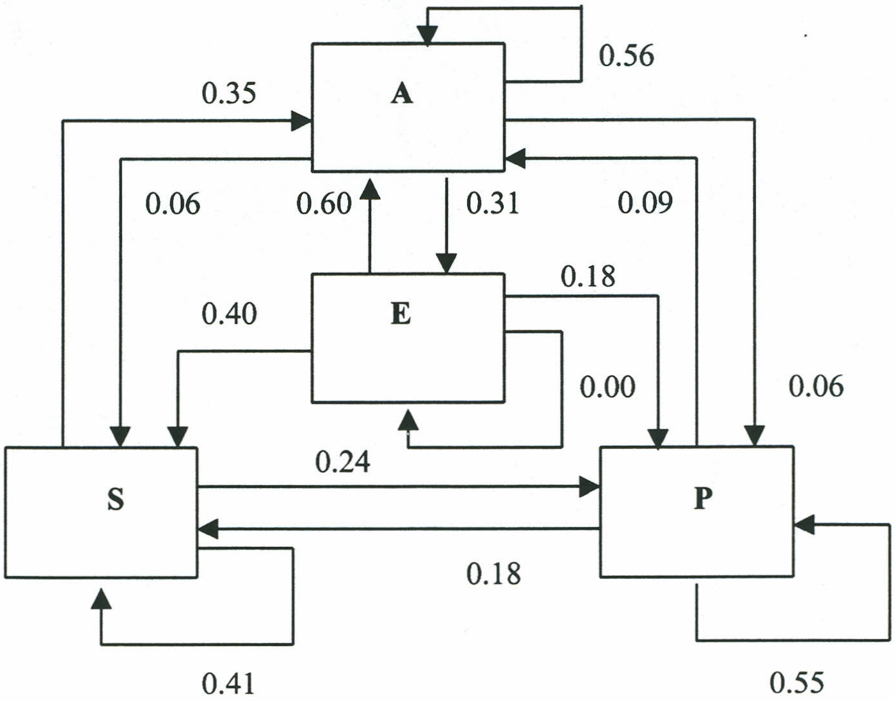
But to get the primary task of the research program under experimental control, it was necessary to model the environments, otherwise it would be infeasible to draw any definite conclusions from ongoing interactions between "citizen and society". It was assumed that a citizen's interaction with his society would foster the development of perceptual strategies in acquiring information on the survival quality of a particular societal context. However, a goal-directed analysis must focus on the interlocking mechanisms that appear to constrain behavioural development. Thus, in Gibsonian terms, "environmental affordances" should have greater controlling and thus measurable influence on this interaction process than any other property (Gibson, 1979). Fortunately, a study concerning the simulation of "interactive behaviour" (B. Bierschenk, 1978) could be made the starting point for the establishment of the paradigmatic foundation of three models making up the "Projections for the Future" (Lee & Mayer, 1976). Each of these models consists of an extrapolation of current trends, and each emphasises one scientific concept: (1) Evolution (physical, cultural) within a humanistic model, (2) Governing and Control (limits implicit in interacting systems) within a growth model, (3) Behaviour Modification (operant conditioning) within a behaviour model.

An application of statistical analysis to the experimental outcome of studies on behavioural development and the principles of repeated measurement usually make these studies meaningful. But in cases where the observations need to be ordered sequentially according to some changes over time, methods for the analysis of recursive and stochastical processes are required (Fisz, 1971). Since it was possible to specify the theoretical value of action-event pairs and to construct state matrices as an expression of recursive actions and events, it was also feasible to establish the theoretical value of the model societies. This was achieved with the results shown in Figure 1. The constructed graph reflects the experimental outcome of the mentioned simulation study.

The letters (A, E, P, S) refer to minute video-taped events, each of which contains a single cue, relating a particular scene to a certain paradigm, namely the paradigm of (1) Association, (2) Structure, and (3) Process. But in this context the letter (E) means a paradigmatically empty scene. A graph of this kind is a radical expression of the concept of "mind" or "memory" as behaviour (Jaynes, 1982, p. 70), because it solely is building on the connection of one part (1) with another part (2).

Figure 1.

Mind as Behaviour (Measured in Transition Probabilities)



It follows that a memory can be constructed with a starting point in any state. The only requirement is that the "mind/memory" construction strictly follows the arrows, which are indicating its developmental process. Perhaps, it may come as a surprise to psychologists favouring the assumptions of constructivism, favouring the point of view, on which Piaget (1963) has built his concept of "competence". For example, a fundamental hypothesis of Piaget states "perception of unstable 'tableaux' with no attribution of substance and depth" (Rochat, 1987, p. 8). As indicated by the formula (1) for recursive events and actions a repertoire (i. e. memory) comes into existence "without any representation of thought" (Piaget, 1970, p. 7).

$$\text{Event}_1 \rightarrow \text{Action}_1 \rightarrow \text{Action}_2 \rightarrow \text{Event}_2 \qquad (1)$$

A comprehensive effort to construct a corresponding computer model has been made by Becker in the beginning of the 1970s. His purpose was to simulate an organism's strategies in building up its "mind/memory". Thus from his rigorous behaviour position, for Becker "mind" becomes accessible through behavioural transformations of the kind shown in the "memory" graph. Moreover, mind has been made explicit by means of a variable system, which appears to be related to some consistent and identifiable characteristics in the theoretical approach to the control of constraining environmental factors.

Concerning the situational complexity, video scenes, based on the A-paradigm are obviously simulating the most concrete conditions. At this level, the environmental circumstances fit neatly into specific, non-threatening compartments.

Everything is or should be in the right place. Less concrete, and considerably more uncertain are the circumstances modelled in agreement with the S-paradigm. Authority and conventions appear less constraining. Moreover, autonomy and self-developing principles seem to emerge as the result of internal self-organisation, which is seen as foundation for complex and abstract judgements. At the most abstract level of functioning, the P-paradigm provides for the conditions of abstract standards and highly articulated functions. In effect, expectations and goal-directedness attribute to the motivation to reach certain standards, which are regarded the sources for motivated behaviour. None of these conditions of reinforcement is present in the transfer of behaviour change from (A, S, or P) to the (E) treatment.

Though there is nothing deterministic in the perceptual process, which would require a definite choice between the inquired variables. Therefore the next step in the development of the research strategy was directed toward the relation between perceptual competence and adaptive behaviour. The established cue structure was used in order to provide an unequivocal definition of the associations between upcoming events and actions, however now with reference to the final state of a particular individual-environment system. Thus, the aim with this formulation of a goal was to construct a mechanism and to set up a device that could be used in the "plotting" of perceptual competence. Strictness in the correspondence between the emergence of an event of certain kind and the appropriateness of the response it elicits could be achieved, because in the present modelling, it was made a strict distinction between "purposive" in the subjective sense and "goal-directed" in the objective sense (Sommerhoff, 1969). However, the present paper deals only with the latter. Hence, it excludes the former and it defines "preciseness" in the working of the proposed "device" through its hit-mechanism, which means the hit of a particular target. Hence the degree of matching with respect to a perceived target condition is the applied definition of competence.

Consequently, the concept of competence has been fix firmly on the definition of a general machine and written to operate in settings, which require a rigorous behaviour position. In its most fundamental delineation a "machine" behaves in a way that its internal state and the state of its environment define uniquely the next state it will go to. What matters in the characterisation of competence is a hit-mechanism, which is independent of the idea that the mechanism must be made of actual matter, but concerns the law-abiding machine-like behaviour that brings about the hit. In the working of the mechanism, it is insignificant whether energy is gained or lost or even created. What matters exclusively concerns the regularity in which event perception and action work together. Hence, before the essentials of the working of the mechanism could be presented in the present form, two factors had to be excluded as irrelevant: the factor of materiality and the factor of energy.

Understanding the constructed simulation "device" as a "Sensing Plotter" for receiving and for responding to stimulus information may be facilitated, if the function space of this apparatus is imagined as a vector space ($\mathbf{M}$) in which actual and virtual as well as possible events may occur. This is expected to generate the behavioural differences ($\mathbf{B} = \delta$) in the transitions and in relation to the emergence of events that can be "seen" and put in relation to appropriate behavioural reactions. Following Cooley and Lohnes (1971, p. 250), the centroid of each sample group on the sub-space of the discriminant functions may be computed as

$$m_{dfk} = \mathbf{B}'(\mathbf{m}_k - \mathbf{m}) \qquad (2)$$

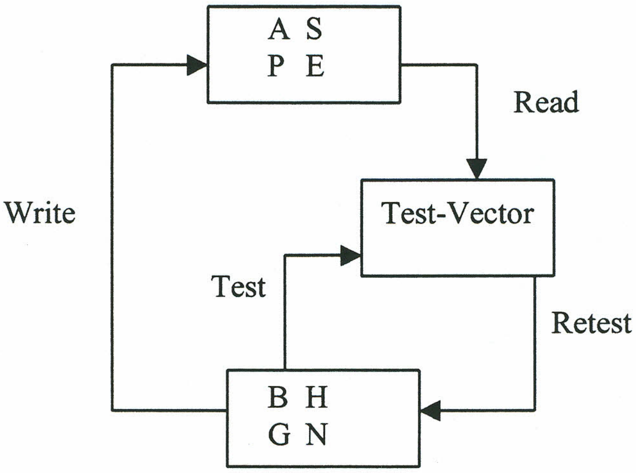
When event and response come together and are referenced to a particular target, both constitute the adaptability of the "Sensing Plotter" and the dispersion of each group may be computed as

$$D_{dfk} = BD_kB \qquad (3)$$

It follows that its design will work properly whenever the initiation of some perceptual activity results in the perception of an event at a certain point in time (t_1) and attention elicits a fitting response at the very same point in time. Provided the fitting response is the result of common population dispersion, the non-zero co-variances in any (D_{dfk}) only represents chance and can be ignored. If this is the case, this condition constitutes hit-invariance, provided a particular target condition is anticipated at a succeeding point in time (t_2). An evaluation of the expressions (2, 3) in relation to the hit mechanism, proposed in Figure 2, has been presented in Bierschenk, Helmersson and Lohmander (1987).

Figure 2.

Imposition of Form on Behavioural Context



Note. A = Association, S = Structure, P = Process, E = Empty,
B = Behaviour Modification, H = Humanist, G = Growth, N = Natural Habitat

The model of Figure 2 requires that response patterns can be identified recursively. Replicable patterns, furthermore, constitutes the basis for the imposition of form in the configuration of environmental constraints along with the integration of the components of a system. Through an immediate apprehension of the layout of these components, it becomes evident that the architecture of Figure 2 exhibits simple cybernetic functions. However, a differential treatment of the letter-symbols is important for the identification of the "conditional assembly" of a state-determined system. But at once, this assembly generates the needed sensitivity for processing subtle but important conditional variations.

In sum: The theme of the present article is the application of a targeted system analysis with the purpose to establish a rigorous behaviour definition of competence.

The application may concern single individuals, single organisations, or societal developments. Whenever a strictly objective and experimental approach is at issue, the developed "Simulation Device" may be of fundamental value in the indication of competence and description of made inferences.

Competence as Behaviour

From a systems theoretical point of view, it can be stated that competition in the form of natural selection operates on "living systems" through their functional behaviour. A theoretically founded simulation of environmental conditions for proper adaptation (i.e., success) must exclude the occurrence of anything unnamed. Thus, a systems-theoretic approach ensures both the referential and formal functions of the "mind" by excluding the occurrence for the "mind" of what is not already "known". As Brodsky (1987, p. 10) has stated it: "the formless, the ambiguous, the unrepresented, or unnamed". In the present context, this means that environmental constraints need to be described with respect to the survival conditions they are expected to simulate for the experimental subject. But in order to distinguish mysterious or accidental events from theoretically significant events, the frame of Figure 2 is a suitable hallmark for highlighting the conditions, which were modelled on the symbolic constraints.

The "Write"-Function

Both conditional variations and the goal conditions, represented by the letter-symbols have an explicit "stand for" property, which is used in the same way as in the production of strings of letters and the application of conventional rules of grammar in communication through ordinary languages. As constraints, the letter-symbols carry theoretical validity, but are themselves independent of the dynamics induced into a particular system. Moreover, the "write"-function has the task to translate the teleological aspect of a system in such a way that a particular "goal" condition, for example making a living, becomes reflected in properly abstracted response patterns.

Translating a model into the place of its inertia is an expression of its theoretical import. The letter (I) at the diagonal of the matrix in Figure 3 represents not only the identity relation of a model, but also its resistance to relational change. Consequently, an identity measure is a measure on its inertial moment.

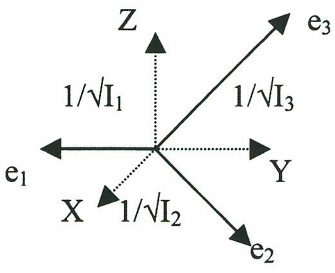
Figure 3.

Time-independent Inertia Tensor

Eigenvalues (e)

$$\begin{bmatrix} I_1 & & \\ & I_2 & \\ & & I_3 \end{bmatrix}$$

Eigenvectors (e)



As shown, Figure 3 (I) takes into account both perceived weights and how the weights are distributed relative to vector rotations in their space of discrimination. The discussion of vector manipulation incorporates some basic arguments from a tutorial of Turvey (1998). Accordingly, founded on the theoretical underpinnings of certain model the inertia (I) of Figure 4 concerns the "theoretical" foundation of a particular societal development.

Figure 4.

Predicted Proportions of the Model Space (Measured with Hays' Omega Squared) [1]

$$\begin{array}{c|ccc} & T_1 & T_2 & T_3 \\ \hline P_1 & .49 & .39 & .16 \\ P_2 & .42 & .63 & .30 \\ P_3 & .77 & .00 & .00 \end{array}$$

Projection	Foundation
P_1: Behaviour Modification	T_1: Paradigm of Association
P_2: Humanist	T_2: Paradigm of Structure
P_3: Growth	T_3: Paradigm of Process

[1] From "A theoretical basis for estimating quality of life," by B. Bierschenk, 1988, *European Journal of Political Economy*, *4*, 323-332.

The projections (e_k) refer to the three videotaped societies mentioned in the introduction. Hence, asymmetries in the theoretical information, carried by the optical device, have been considered to be of functional import in the subject's perceptual accommodation. For example, the "write"-operation rests on the channelling of an irreversible flow of information from the source, which relates to conditional variations and contains the projected models, to the sink, which relates to representations and attracts and accepts certain forms of behavioural control. Hence, the axes that are pointing in the direction of the eigenvectors constitute the geometric representation of the inertia tensor of the corresponding displacements.

The special values of the nine numbers in the matrix of Figure 4 dependent on the co-ordinate system defined on the fixed (zero) point of rotation. Hence the inertia tensor is an array of nine numbers that quantify the theoretical value and guarantee an efficient determination of the principal moments. One distinct outcome of this type of informational specification has become manifested through the "write"-function. The corresponding operation is illustrated in Table 1.

Table 1.

Focal Condition (FC)

Model	FC	Centroid
M_1	B|A	m_1r^2
M_2	H|S	m_2r^2
M_3	G|P	m_3r^2

The particular property of Table 1 is the discriminative power of the theoretical weights that could be attributed to the models of simulation. Basically, the measure (r) as well as its generalised versions in the form of Hays' omega (ω) and Wilks' lambda (η) has been obtained by multiplying the weight (index value) of each model by the square of its distance from the rotation axis and by summing across all models. Thus, the multiple correlation is identical with the standard Pearson product moment correlation between precisely two variable values. The first one (X_i) is associated with the model component of Figure 2 and the second one (Y_j) is referring to a linear combination of the conditional statements, that have been made public in B. Bierschenk (1978). Moreover, Lord and Novick (1968, pp. 265-266) have shown that it is also the maximum correlation that can be obtained between both (X) and (Y). The corresponding matrix of the time-independent inertial tensor is given in Figure 5.

Figure 5.

The Inertia Tensor

$$\begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{xz} & I_{zy} & I_{zz} \end{bmatrix}$$

As stated earlier, the establishment of a Q-criterion is emphasising the invariants of ecological information (B. Bierschenk, 1989). These are the principal moments, which are defined with respect to the (XYZ) system of reference. Due to the assumption of ecological optics, the lawfulness of an ambient optic array at the point of observation enters the theoretical foundation, but only as criterion. This means that its operationalisation by means of the Q-criterion is addressing the causal relations between perceptual sensitivity and the information picked up concerning the consistency of identifiable Q-properties. This relation was anticipated in the focal condition of Table 1 and was implied in the rotation through the principal axes of Figure 5. The measure of a model's resistance to displacement, that is a change in its rotational motion is termed the model's "moment of inertia". It is a measure that is determined by the rotation of the system until an orientation of the axes is found that is maximising the explainable variance of a data cube. In this way the system is taking into account a particular subject's response tendencies when he is placing himself in the centre of a certain model and asked for his immediate reaction.

The "Read"-Function

Sommerhoff argues that it is sufficient to assume that ($\mathbf{m}_k$) is theoretically possible. Furthermore, it is irrelevant to consider whether and to what degree anyone has been successful in perceiving him-self at the certain centre ($\mathbf{m}_k$) of a particular society or whether those perceptual displacements have been exercised experimentally. The starting point of this reasoning may be found in Gibson's (1979) theoretical underpinnings of the "Visual Cliff" experiment, carried out by Gibson and Walk (1960). This experiment was concerned with the visual perception of an "environment quality" (Q), which Gibson (1979) conceptualised as an affordance, albeit a negative one. As he argued, the environmental quality of "height" or "depth" may have negative consequences for survival of a certain species. Hence, no matter of the realness or virtuality of the variations in (Q), all models are depicting some condition in the coenetic relationship.

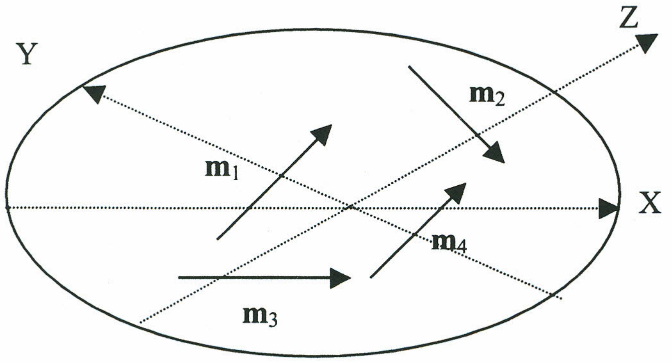
It is only natural to assume that perceptual clarity (i. e., certainty) dependent on the proper functioning of "reading" the theoretical value by extracting or abstracting environmentally significant cues. In this sense, perceptual clarity is always synthetic. But there is a fundamental difference between the description of a global system phenomenon in the analytical terms of familiarisation on the one hand or in terms of perceptual synthesis on the other. From the perceptual point of view, the behaviour of the members of a society relies on their sensitivity to what "a particular environment offers to them" (Gibson, 1979). Sommerhoff (1950, 1968, 1969, 1990) has provided a wealth of examples that allow a rigorous definition of Gibson's idea of an "offer" through Sommerhoff's concept of "Focal Condition" (FC). Therefore, it has been of import to find the informative components of (FC). How it can be indexed and used is of central import to the present study. The idea is that human achievement can be given an unambiguous definition by relating (FC) to the concept of "perceptual competence". This implies that the notion "competence" will be conceptualised in the tradition of analytical biology and given the "demonstrative definition" outlined by Sommerhoff (1969).

Hence, a particular environment becomes "readable" provided that a system (i. e., a civilisation) has come into existence. The approach used in the present study is stressing the contribution that apparently disparate civilisations can make to a person's "read" experiences with various physical and social surroundings and the achieved cognitive integration of these surroundings.

The distinctive character of citizenship is observable through those activities of the members of a society that are directed toward the development of a civil code and hence an appropriate civilisation. The expression "appropriate" (Sommerhoff, 1950) refers to the degree of adaptive behaviour of a particular citizen in relation to the civilisation in which he is expected to make a living. The hard core of the concept of "civilisation" refers to the "reading" condition. According to Ross Ashby's (1968b, p. 108) argumentation and mathematical conceptualisation concerning the correspondence between the theory of communications and Fisher's (1946) Analysis of Variance (ANOVA), this property may be treated by means of its generalisation into the General Linear Model (GLM). Hence the fundamental aspect of a (GLM) analysis of the concept of citizenship refers to a "function space" of Figure 6.

Figure 6.

*The **M**-Space Related to the Euclidean XYZ-Reference System*



The way in which the prerequisite of variation in the present context has been configured is shown in Figure 6. In correspondence with the relations, established in Figure 5, the co-ordinates of the **M**-space have the control variables (XYZ) as their axes of reference. Whenever an experimental subject is exposed to the spatial-temporal relationship of Figure 6, an appropriate reaction is expected at time (t_1), provided the reaction stands in proper relation to the FC at time (t_2). This is physically possible only under the condition of joint causation. For the accurate understanding of this process, it is important to realise that the definite functioning of this design is conditional on **(m)**, which, however, secures uniformity in exposure. This means that the design is determining any response pattern, because Figure 6 is objectively so configured that alternative configurations of **(m)** would probably cause the occurrence of alterations in the abstraction of the patterns of response.

Sommerhoff has conceptualised this space in his model of a "convex lens" (Sommerhoff, 1950, p. 60). Thus, the "discrimination space" will be used as general frame of reference in the deduction of the "reading" capability of a particular experimental subject and in particular its implications for competence development. In strict agreement with Sommerhoff's own exposition of the "Lens model", the present outline will continue with the anticipation of a certain societal development or contextual variation. The course of development is expected to start at time (t_0) where the simulation process is in state (S_{t0}). To say that contextual variations develop leaves open at least two different reading conditions.

The first one may be exemplified by means of the fancied Society of Civil Engineers and Technologist at Lund University. Membership (M) in this society is expected to start with a simple and unobjectionable partitioning of students into two sets. One contains the novice students and is named "zeros", which are "even" and the others are named "ones". These are the old-timers, which are "odds". Now under the simple law of association of this particular world of Technologist, the "evens" are "reading" the code with the purpose to become "odds". Successful reading changes their state of struggling into the state of membership by "addition". Hence, from being independent, they have become dependent. "Addition" is forming a particular connection. In general, any society can be viewed as a "writing-reading-rewriting", and consequently "self-connecting system" of zeros and ones (Ross Ashby, 1968b, p. 113). The change is from independence between autonomous individuals to membership and it is the result of a connecting function.

The second illustration of the "reading"-function may be approached in the following way. At time (t_1) membership (m_{t1}) may be representing a change due to the influence of a variable retaining some properties of the FC that are essential qualities (Q) for system development. Consequently, (Q) is the global system property, which may be conceived of as the ultimate product of any civilisation.

The Test-Vector

In a number of experiments, experimental subjects have been asked to mark their "degree of certainty" concerning the fitness of their responses to particular sequences of events. On the basis of the I-reference in a set of items (p_j), where $j = 1, 2, \ldots, 15$), various states have been indexed according to an interval scale, where (1) marks "very uncertain" and (9) indicates "very certain". In the process of responding, a perceiver may be very confident of his conceptual basis, but in relation to the objective of particular **($\mathbf{m}_k$)** apparently quite uncertain of the actual state of its (Q) property. It is now mandatory to specify (Q) at (t_2). It is most likely that (Q) must refer to the properties of a particular **($\mathbf{m}_k$)** that allows survival. Hence the concept of survival must be translated into perfectly rigorous terms. From the viewpoint of **(m)** it is clear that a variety of states are acting and thus determining one's way of making a living.

So, the criterion for (Q) is always related to the constraint that adhere both to **(m)** and to the experimental subject. The particular states of **(m)** which are corresponding to the individuals success of prospecting his living in **(M)** are then those states in which (Q) is kept within certain limits.

In order to separate experimentally the fitness of (r_{t1}) in relation to particular ($\mathbf{m}_{t1}$), it is important to note the functional relation

$$[Q = FI * FII = 0] \tag{4}$$

Expression (4) is founded on two principal components. Both are the result of a number of three-dimensional factor-analytic studies. These have been carried out in agreement with the design matrix of Figure 7. This matrix shows the resolution of a three-dimensional data box into two-dimensional slaps.

Figure 7.

Design of Performed Factor Analyses

$$\begin{array}{ll} & \text{LQ-proposition} \\ & p_1\ p_2\ p_3,\ldots,p_{15} \\ \begin{array}{l} Id_1\ldots Id_n\mathbf{m}_1 \\ Id_1\ldots Id_n\mathbf{m}_2 \\ Id_1\ldots Id_n\mathbf{m}_3 \\ Id_1\ldots Id_n\mathbf{m}_4 \end{array} & \left[\begin{array}{c} \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\ldots\ldots\ldots\ldots\ldots \\ \ \end{array}\right] \end{array}$$

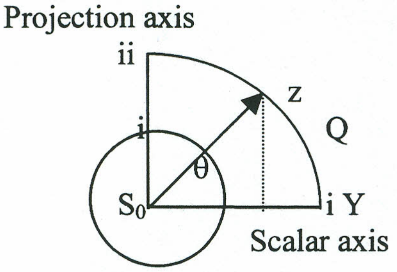
The models ($\mathbf{m}_1 \ldots \mathbf{m}_4$) have been used in the grouping of the collected observations (x_{ijk}). These have been systematised in an adaptive manner. This circumstance is mirrored in (Id). It means that an individual, taking part in one projection, is conceived to be a different individual in another projection. Thus, the implementation of a form of measurement concerns the establishment of the mentioned test-vector. It is expected that a test-vector can represent sequences of imagined alternatives to actual events as well as actual event sequences. From a constructional point of view, a sequence of events may be varied freely as long as it follows some principles for variation in the theoretical representation. Hence, appropriateness is always within limits, because it must respect some chosen principle and a set of proposition. No analytical design will ever have the capacity to cope with all conceivable dependencies.

The "Test-Retest"-Function

A formal determination of the "arrangement for simulation" requires a differential treatment of the flow of information, because a successful extraction of the ecological invariants, associated with (Q) is dependent on the establishment of a dynamic, but consistent relationship between source and sink. In agreement with the "Gibsonian information law" (Kugler & Turvey, 1986), it can be assumed that perception of (Q) is a function of informational invariants. Moreover, for the process of measurement, the operating variables have to be organised in a way that provides for successful transformation, since both the dynamic properties of (Q) and the perceiver's visual exploration are determining the degree to which invariants are extractable. It follows that the arrangement has to be patterned, because its task is to provide for the establishment of a matching relation between modelled information and some magnitude or response measurement. The matching between both has been conceptualised as the angle of a line segment, originating in a source (S_0). Figure 1 is representing (r_a) as response-vector, whose appropriateness has been set in relation to the event-vector (e_k), and both have been referenced with respect to a vector for the essential property (Q).

Figure 8.

Appropriateness in the Event (e_k) Response (r_a) Relationship



S_0: Origin of Information Flow
Q: Environmental Property
Z: Identity Spinor (I)
$(I^*Y) = \cos\theta$; $(I\wedge Y_a) = i \sin\theta$
$(I_{yy}) = e^{i\theta}$, where $\cos\theta + i\sin\theta$

The aim with Figure 8 is to identify explicitly the principles of construction for the test-retest operation. Since transformation implies a rotation of ($Y = r_a$) through the right angle

$$[\cos\theta + i\sin\theta], \qquad (5)$$

Expression (5) suggests that the multiplication by (i) is performing the necessary step in the determination of a unique position (z) on (Q). In the counter-clockwise rotation, the absence of spatial discrimination means no sensing, which is formalised in expression (6)

$$[I_k \wedge i = 0]. \qquad (6)$$

Hence, no pickup of ecological significant information is implied. So the “right angle” is instrumental in the specification of a focal condition and in the extreme case the determination of the degree of “confounding”, which implies

$$[r_a = e_k]. \qquad (7)$$

From the perceptual point of view, it follows that the initial state (S_0) is defined by the relationship

$$[S_0 = \lambda\, i]. \qquad (8)$$

In this relation is the zero-state of information pickup symbolised by (S_0), while the angle ($|\theta|$) specifies the magnitude in the information picked up. In factor-analytical terms, it can be stated that a vector rotation determines a unique position on the Q-curve by means of the point (S_k) where the flow of information in the perceptual array becomes concentrated. When the test-retest operation is made dependent on the extraction of factor-analytical components, the test is defined in terms of an "outer product" (Hestenes, 1993), and it can be concluded that the first step must concern the indexing of differentiation in an individual response.

The test-retest operationalisation of perceptual sensitivity and degree of responsiveness are fundamental for the proper functioning of the simulation. Hence, a vector of a corresponding data matrix, originating in (S_0) is in general of standardised length and pre-multiplied with another vector of the same kind. However the extraction of an eigenvector has the special variance property that is resulting from the utilised procedure for rotation, e. g. extracting a maximum of variance. Ultimately, when the eigenvalue of a factor is ($\lambda>1$) the latter takes part in the determination of appropriateness. It follows that any local interaction between modelled information (e_k) of the simulation arrangement and responsiveness (r_a) can be represented as vector-valued state function. Of course, this measure must be consistent with the ecological property (Q) of a particular physical space.

Furthermore, (Q) is achieved of in a step-by-step manner, which in a fundamental sense is made dependent on the achievements of the "test-retest"-function. The presence of membership (M) at time (t_1) is equivalent to the existence of a constraint in a space of possibilities. It follows that (S_{t0}) generates a variety of (m), where variety is indexed by ($k=1,2,\ldots$). Hence, (M_k) may be looked upon as a particular subset of individual-environment interactions, which have been indexed as vector variable ($\mathbf{m}_x$). However, the space represents also the "degree of certainty" as indexed through (r) at time (t_1). It follows that the efficacy of the "test-retest"-function can be evaluated by the expression:

$$[\mathbf{m}_x = M_{t1} * R_{t1} = 0], \qquad (9)$$

In the relation, (M_{t1}) refers to a particular membership, while (R_{t1}) represents the proper adaptation to a present society. However, (R_{t1}) may change, if the experimental subject is changing his "reading" or two different subjects are using two different positions of the discrimination space when they are responding to one and the same event (Ross Ashby, 1968a, p. 299; Sommerhoff, 1969).

However, varimax rotation and repeated factor-analytical evaluation of the obtained "certainty in judgement" have made it possible to demonstrate the existence of two orthogonal components. These have high reliability and work with remarkable precision. In fact, the data sets recently provided by Ole Elstrup Rasmussen at the Psychological Laboratory of the University of Copenhagen have shown that the effect of the operating variable (**m**) can be expected to be in the range of eta (η) squared which comprises ($\eta^2 = 0.80$ to $\eta^2 = 0.90$). An effect of this size is remarkable, because it is of an order of magnitude that is foreign to behavioural studies (Cohen, 1969, pp. 75-76). In the study of (**F**), the criterion itself appeared to account only for the tiny variance portion of ($\eta^2=0.016$). This result shows that the employed procedures of measurement are independent of the expected experimental outcome. Moreover, (**F**) was associated with ($\eta^2=0.000$).

Further, if it is assumed that (Q) is an ecological property of global consequence, its effect can be made explicit by means of the expression:

$$[\mathbf{F} = f\ Q] \qquad (10)$$

The proposition of expression (8) that can be made the basis of the test-retest operation, because, as was indicated, appropriate numerical values have been made available. Hence, no matter of the realness or the virtuality of the variations in (Q), from a psychometrical point of view, it is a straightforward operation to obtain unbiased estimates of the involved variance components. In conclusion, the inertia tensor, underlying Figure 7, has the capacity of capturing differences in resistance concerning a model's rotation in different directions.

Actually, **(F)** has a key function in understanding the ability of an experimental subject's visual focusing on (Q). In contrast to the vector space of Figure 5, a tensor space denotes a position, determined within the context of more than one co-ordinate system. Vector and tensor spaces are related by a transformation law, which suggests that the tensor itself has not changed during transformation. But **(F)** also may be treated as bivector, because it is forming a measurement or product space. Since both components are the result of orthogonal rotation, it can be concluded that the following "outer product" relation is valid.

$$[\mathbf{F} = \mathrm{FI} \wedge \mathrm{FII}] \qquad (11)$$

Expression (11) means that the value of one of them at any given point in time is independent of the value of the other at the same point in time (Hestenes, 1993, pp. 16-30; Sommerhoff, 1969). However, this circumstance does not exclude the possibility of a perpendicular relationship, namely that "inner product" relation is valid.

$$[\mathrm{FI} * \mathrm{FII} = 0] \qquad (12)$$

It has been shown empirically that this relation of expression (10) in fact exists in a data set provided by Elstrup Rasmussen. Hence, concerning the functional identity of **(F)**, there must be given and specified a set of perceptual displacement responses. The values associated with the involved perceptual activities must be related to those dispersions that force the determined (FI) away from its counterpart (FII). The variance-analytical evaluations of their proper functioning show that **(F)** is non-correlated with **(M)**, which means that the proportions of variance, associated with **(F)** can be expected to range between (η^2=0.000) and (η^2=0.03). Since this result must be conceived of as a demonstration of proper functioning of the inner array of the design of the present study, it can be concluded that unbiased experimental effects can be expected.

The Co-ordinates of Competition-Success-Flexibility Space

If "conditionality" is a basic aspect of **(M)**, so also is the assumption of competition in **($\mathbf{m}_k$)**. Competition between individual members is often treated as if it were essentially biological. However, it is an expression of conditionality as soon as the relation between two or more members becomes conditional on the state of a particular **($\mathbf{m}_k$)**. Competition is expected to lead to modifications of membership and consequently probable patterns of behaviour. As Ackoff and Emery (1972, pp. 199-201) have noted, the psychological literature is rich of qualitative discussions of competition. One of the most common speculations concerns the presence or absence of physical force influencing the members of a society. When it is present, it suggests non-co-operative behaviour. In contrast, its absence is assumed to lead to competition, which favours survival as a member as well as the generation of new members. Some form of learning also favours competition as an objective system property.

All studies since the 1920s have been inconclusive concerning the relative effects of co-operative, competitive, and individualistic success (Johnson, Marnyama, Johnson, & Nelson, 1981). Moreover, most of the conclusions put forward in the social sciences are shear non-sense (Ackoff & Emery, 1972, p. 9). For example, it is said that group performance is the sum of independent individual performances, which determines individual reward. Therefore, competition (for reward) adds additional interest to what might otherwise be a dull task. Under these circumstances, motivation would be great in competition. Ackoff and Emery are making the judgement: "More trivial results are hard to imagine".

Formally stated, ($\mathbf{m}_k$) may be seen as a configuration of constraints of individual life, but also as an accumulation of successful solutions to the problem of selection and achievement or success (Foerster, 1968, p. 171). For example, the educational system of a particular ($\mathbf{m}_k$) can be assumed to be compatible with the mechanisms that generate civil life and that favour survival. From a spatial-temporal point of view, it follows that (Q) may be conceived of as a criterion that is co-extensive with the function of survival (i.e. success) as well as the challenges posed by a particular civilisation (i. e., competition). In this sense, ($\mathbf{m}_k$) always will carry a relative notion. It is implied that it must be conceived of as a fundamental condition, but nested under the "Competition–Success" (C–S) mechanism as shown in Table 2.

Table 2.

Two-by-Two Factor Model for the Indication of Level of Competence

Nesting of (M)	Competition (C)	
Success (S)	Frozen	Unfrozen
Frozen	$\mathbf{m}_1$	$\mathbf{m}_2$
Unfrozen	$\mathbf{m}_3$	$\mathbf{m}_4$

It is worth noting here that the novelty of the design of Table 2 refers to an asymmetric relation. Nesting societal development makes it dependent on the (C–S) mechanism's differences in degree of flexibility. But these differences can only be made explicit in terms of Sommerhoff's concept of "directive correlation". Finally, there has to be a criterion, which manifests the occurrence of flexibility. It is at this point, where the aspect of competence enters the second reference system and thus into the process of measurement.

A formal determination of the arrangement of Table 2 requires a differential treatment of the flow of information. Successful extraction of the ecological invariants, associated with (Q) is dependent on the establishment of the system, which consists of the (ABC) axes of reference. In agreement with the "Gibsonian information law" (Kugler & Turvey, 1986), it can be assumed that perception of (Q) is a function of transformational invariance. Moreover, for the process of measurement, the operating variables ($\mathbf{m}$) of the first system of reference have to be organised in the way shown in Table 2, since both the dynamic properties of (Q) and the perceiver's visual exploration are determining the degree to which informational invariants are extractable.

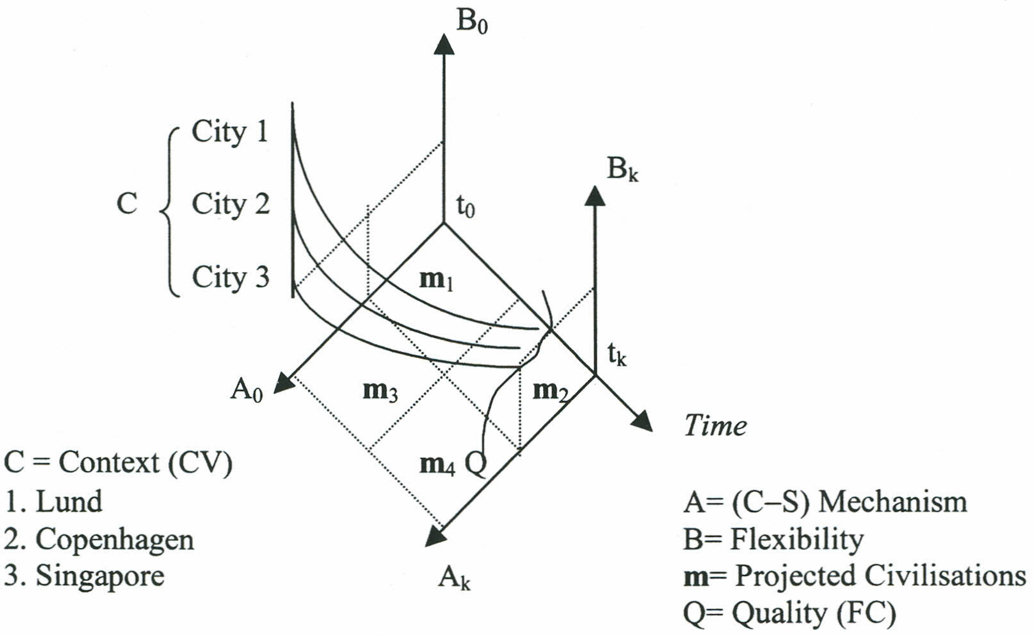
Within the framework of experimental modelling, multivariate statistical analyses of variance constitute the basis for an empirical evaluation of the design, shown in Table 2. Experiments and measurements, more or less in correspondence with the presented approach, have been carried out during many years of study. These have been made available through the following publications: (B. Bierschenk, 1987, 1988, 1989, 1992, 1997, 1998a, 1998b, 1998c; Bierschenk, Helmersson, & Lohmander, 1987; Bierschenk, & Marker, 1998; Bierschenk & Yuen, 1998; I. Bierschenk, 1997, 1998a, 1998b; Elstrup Rasmussen, 1998b; Yuen & Bierschenk, 1998).

Models as Function of Accommodation

The assumption is that any recognition or measurement and discrimination or classification depends on a criterion. On the basis of a criterion, which has the capacity to reflect "accommodation", the perceiver of a projection can be evaluated. It is this dynamical system behaviour and in particular the asymmetric development that provides the basis for learning about and describing a society of certain kind. This situation is transforming "membership" into the mentioned "individual-model" relationship, which can be captured formally as shown in Figure 9.

Figure 9.

The ABC System of Reference



The fundamental contribution of Sommerhoff is his analytical approach to the directedness in living systems, which is expressed in his "design", concerning the properties of open systems (Sommerhoff, 1969, pp.178-180). This design has been made basis for a conceptualisation of the subtle but important difference between a time- and state-determined treatment of "conditionality". The fundamental idea of his description is an irreversible information flow from the source (CV) to the sink (FC). It follows that his coenetic variable describes an objective property for real as well as for virtual systems. Sommerhoff's operational treatment concerns the successful matching of dynamic interaction, which is represented by some magnitude of information pickup. When this magnitude constitutes a perfect match between (CV) and (FC), both constitute the perfect expression of a causal relationship.

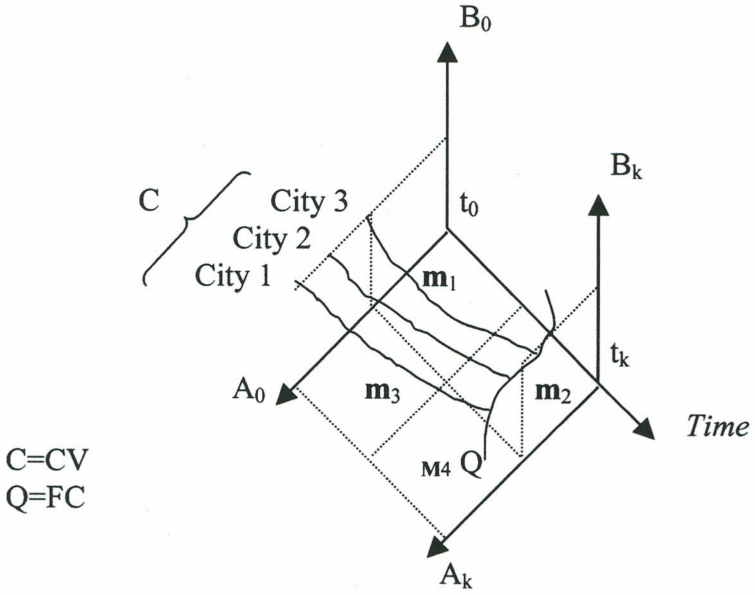
As outlined in the preceding sections, the operating variable ($\mathbf{m}_k$) is expected to influence in a constraining manner the elicitation of a response. The fourth operating variable is, however, theoretically "empty" or at least "blinded" and consequently unknown, since it refers to a citizen's "Natural Habitat". But, adjustment of perceptual sensitivity to possible changes in a sequence of events needs to be controlled, which presupposes the processes of projection and imaging.

Further it is assumed that perceptual activity (a) is encouraged through the display of the models ($\mathbf{m}_1 \ldots \mathbf{m}_3$). Each of the (**m**'s) is a designed projection and carried by a picture series. The used slide series contain particular sequences of events making up episodes that are expected to attract attention to some fundamental conditions of societal life. For the present purpose, this framework has been resolved into a sequence of frozen acts that are videotaped for the convenience of presentation to an audience. Hence each act is discrete and contained in a frame. Those frames are fixed within the series to which it theoretically belongs. Any transition from one frame to another is governed by a step-function. It follows that any projection is connected to this particular form of presentation. Furthermore, the frames have recently been provided with Danish and Swedish text and transferred onto a CD-ROM (Elstrup Rasmussen, 1998a), which allows for a greater degree of flexibility in the presentation. Finally, each cycle of presentation depends partly on the theoretical conditions and partly on the presence of proper response variables, which at present consist of propositional statements in the form of items as was shown in Figure 9.

It follows that the degree of measured accommodation is dependent on the elimination of ambiguity in the generation of these processes. It is the purpose of Figure 10 to keep the appearance of any disturbances under control.

Figure 10.

Flexibility Adapted to the C–S Mechanism



With projections and imaginations, represented as intermediary (**m**) of the dimensions of "Competition" and "Success", their influence on the unidirectional flow of information can now be determined. This determination is from an optical point of view the necessary condition for anticipation of possible alternatives in the pattern of response. The layout of the design of Figure 10 is consistent with the variance analytic design that will be presented in Table 3.

Table 3.

Set-up of a Balance AB-Design

Block 1	Block 2
$AB_{11} \leftarrow \mathbf{m}_1$	$AB_{12} \leftarrow \mathbf{m}_2$
$AB_{22} \leftarrow \mathbf{m}_4$	$AB_{21} \leftarrow \mathbf{m}_3$

The formally defined components shown in Figure 9 constitute the basis of the presented ANOVA design. Thus, the components can be grouped into two sets of variables. A balance with respect to the main effects of both sets can be achieved by means of the shown blocks. The digits in the cells of Table 3 refer to a particular level in a certain factor. Further the underlying model is strictly additive with respect to the block effects. The effect of a particular treatment is estimated by means of a comparison of the mean observations for the involved treatment. The purpose is to compute the residual, corresponding to each original observation according to the definition given by Cox (1958, p. 29). Hence the underlying model of the block-design of Table 3 has no terms for the estimation of any interactions with the block effect. Consequently, the experimental units are grouped into blocks in order to eliminate the difference between the sums for the blocks. Furthermore, the treatment factors as well as the block-factor are treated as fixed factors. This means that the obtained results are valid only with respect to the actual definition of the levels in the factors.

Method

Participants

The participants of the present study have been described recently (Bierschenk, & Marker, 1998; I. Bierschenk, 1997; Bierschenk & Yuen, 1998).

Materials

The description of the materials of projection can be found in an extensive summary report (e. g. I. Bierschenk, 1997; Elstrup Rasmussen, 1998).

Design and Procedure

In the present context, the notion “block” refers to the source of experimental material, which must be controlled in order to eliminate block difference from experimental error. If this added control can be achieved, it would mean that “indications of perceptual competence” would be measurable with increased precision. Precision in experimentation and measurement requires that a treatment effect can be kept free from variations between so-called blocks (Winer, 1962, 604).

Obviously, one set must contain the variance-analytic factors: (A) and (B), which are the control variables of the “outer array” (Hestenes, 1993) of the design. The other set refers to the “inner array” of the design, which contains the operating variable ($\mathbf{m}_k$) of this design. Both sets are under the control of the experimental program. It is worth noting that each level appears once and only once in each block.

Thus there is a balance with respect to the degree of "flexibility" in the arrangement of the operating variables.

As stated, citizenship is observable through those activities of the members of a society that are directed toward the development of a civil code and hence appropriate pattern of behaviour. It follows that a third variance-analytic factor (C) was needed to determine the degree of fitness in relation to the contextual variations (CV) in which a particular citizen is expected to make a living. Adding a further factor to the outer array means an expansion of its space. A balanced representation of this change in the design implies also a change in the size of the blocks of Table 2. They now contain six treatment combinations. However, the (AB) (AC) and (BC) interactions require adjustment for the block effect. In referring to Winer (1962, p. 606), it follows that the difference between the sum of all observations in block (1) and (2) is a function of the (ABC) interaction.

Now, the functioning of the blocks may be reconsidered with reference to the extension with the levels of factor (C). This factor refers to the experimental control of any initial conditions for the development of individual life. It follows that there is a variance component for each "city" that corresponds with one particular condition of success and competition and no other. But all treatment combinations are taking part in the manifestation of the degree of consistency that is associated with a particular response pattern.

In considering the blocks as a summary of a three-dimensional arrangement, it should become obvious that the models are locked in certain ways. They are expected to represent different cause-effect assumptions about "Competition" and "Success" in equal fashion to the participant of any city. Hence the blocking of interactions is expected to adjust for confounding effects. It follows that the proportions of variance attributable to co-variation and interaction between certain components and their composites will depend on the way in which they are organised for estimation. Since preciseness in the working of the blocks is related to proper partitioning of its components, the property of blocking can be treated within the framework of the General Linear Model (GLM).

The computation procedures for all factorial effects are formally identical with those of a factorial experiment, in which there is no confounding. Finally, the addition of the CV-component is expected to control the variations in the original observations that are attributable to atmosphere or pressure of the particular present-day conditions of the participants. For example, sampling errors as well as an increase in the number of observations may have different effects on the statistical evaluation of a treatment effect (Cronbach, Gleser, Nanda, Rajaratnam, 1972; Lindquist, 1953, p. 11).

By integrating the results of the experimental studies of the last two years (1997, 1998) into the presented framework, it will be demonstrated that (LQ) basically is a function of ecological affordance. But it will also become obvious that (LQ) can be measured only to the degree that a given environmental condition, for example a particular city or an entire society has the capacity to induce a certain dynamics into the measurement system. Moreover, it will be demonstrated that the division into block (1) and block (2) is a measure, that adds strictness to the evaluation, but the procedure has a price, i. e. a partial confounding of the (BC) and (ABC) interactions. But this inconvenience is negligible. The corresponding alternative, but weaker MANOVA model shows only tiny fractions of variance associated with these terms of interaction. In agreement with the model of Table 4, expression of perceptual competence is a function of certainty in judgement of the actual conditions for successfulness and competitiveness. Therefore, all involved factors have been treated as "fixed". A remarkable result of the presented approach is that the conditions clearly can be expressed in degrees of freedom (DF), provided this measure is adjusted for the block effect.

Table 4.

General Linear Model for the ABC Design

Factor	Type	Levels	Values		
Block	Fixed	2	1	2	
Competition	Fixed	2	1	2	
Success	Fixed	2	1	2	
Context	Fixed	3	1	2	3

Hence, this (GLM) design will be used in the statistical evaluation of the effectiveness of the experimental treatment conditions. This way of analysing the results of Table 4 means a deviation from the common concern in the behavioural sciences, namely correlation studies.

In contrast, the present analysis is primarily concerned with the proportions of variance associated with a particular treatment and not with treatments in general. These proportions have been estimates with a concentration on the promotion of **one** main effect. Moreover, the F-ratio, whose value appears to be less than (F=1.00) needs to be treated as zero, because in those cases is the judgement of the involved relation uncertain. The necessary computation has been carried out with the GLM-procedures of MINITAB (1998) and is reproduced in Table 5.

Table 5.

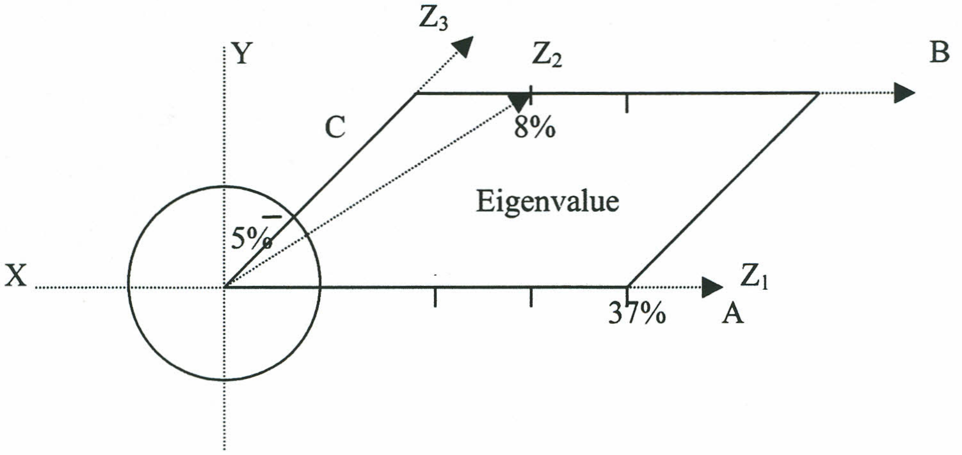
ANOVA for the Factors (FI, FII), Using Adjusted Sum of Squares for Tests

Source	DF	Seq.SS	Adj.SS	Adj.MS	F	P	η^2
Block (FI)	1	1.8	1.8	1.8	0.47	0.491	0.000
Compete	1	3998.6	3999.4	3999.4	1062.28	0.000	0.367
Success	1	907.7	907.7	910.7	241.89	0.000	0.084
Context	2	563.4	563.4	281.7	74.82	0.000	0.051
Error	1441	5425.3	5425.3	3.8			
Total	1446	10896.9					
Block (FII)	1	12.87	13.06	13.06	0.68	0.410	0.000
Compete	1	3.64	3.50	3.50	0.18	0.669	0.000
Success	1	848.41	850.43	850.43	44.26	0.000	0.026
Context	2	4120.52	4120.52	2060.26	107.24	0.000	0.126
Error	1441	27684.99	27684.99	19.21			
Total	1446	32670.43					

It is instructive to consider Table 5 in relation to the measured function space. In strict agreement with the exposition of the controlling design, the distinctive character of the constraining operation relates to the directionality that has entered asymmetry into the rotation. The degree to which perceptual sensitivity and judgement concerning "Eigenvalue" has resulted in a measure on distance is summarised and illustrated in Figure 11. Distance is represented and marked with the spinor (z). All bivectors (z) of the outer experimental array are of the type [a∧b] and are depicting some orthogonal conditions controlling the responsiveness of the experimental subject. As a result, controlling the contribution of contextual variations to the explainable portions of variance requires a further control relationship [a∧b∧c], which is just the torus of the outer area, but can never be determined in any absolute sense.

Figure 11.

Combined Rotations on the Basis of the Principal Component (FI)



Testing the moment of inertia hypothesis concerns the indexed proportions of variance. These are manifested by the perpendicular Y-axis and expressed with (η^2) the following eta: [A: $I_{yy} = 0.37$; B: $I_{yy} = 0.08$; C: $I_{yy} = 0.05$].

The A-vector illustrates the case where perceived "survival potential" is closer to the subject's ability to imagine his possibilities of development. Hence, each possible value of the joined factors forms the origin of the interaction lines that start in the origin of Figure 11 and must intersect the (ABC) system in unique fashion. The terms of the first principal component demonstrate clearly a differential power, which aggregates to (50%). But the "Competition"-vector locates the involved cities with "Context"-vector as indistinguishable.

In sum, there is **one** main effect, namely "flexibility in competition", which accounts for about (37%) of controlled variance proportions. It follows that the condition of competitiveness is of societal significance. Further, it implies that perceived possibilities for "Competition" are in a fundamental sense determining the course in the development of "Eigenvalue".

It follows that "flexibility" is an objective system property. This property constrains individual life and thus, determines the perception of a certain level of (Q). The involved system constraints are observable through the working of the operating vector-variable. It can be concluded that the flexibility in this condition is dependent on the presence of behavioural disparity. It follows that the hard core of the concepts of citizenship and civilisation refer to "flexibility in competition" as significant and with certainty perceived societal affordance.

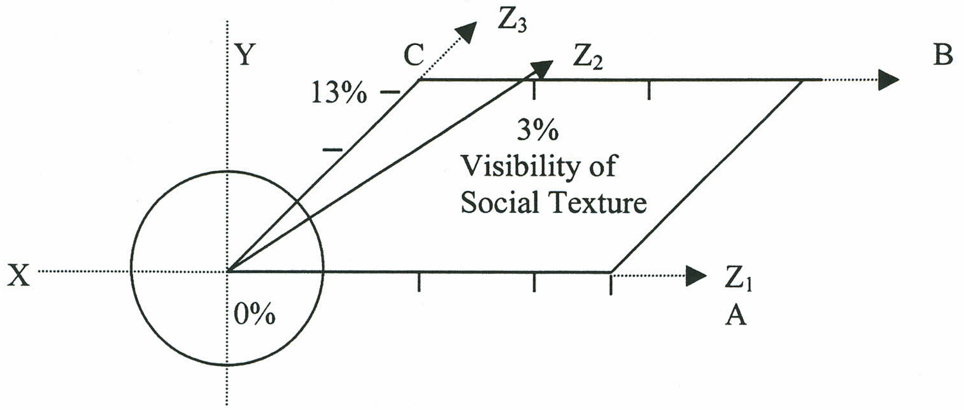
In contrast, the participants are uncertain concerning the dimension of success and its influence on the possibilities for their development of "Eigenvalue". Accounting only for the tiny fraction of 8%, it can be said that the development of "Eigenvalue" to an insignificant extent is controlled by "flexibility in success". Furthermore, the particular context of the participants accounts for even less (ca 5%) of the demonstrated variance. This means that the cities of Lund and Copenhagen as neighbouring regions of Northern Europe have produced citizens who in their basic outlook differ only marginally.

The indicated co-variation of Eigenvalue with perceived competitiveness means that all participants have some method at their disposal for picking up directly what comes into their view concerning competitiveness, what is offered to them, and what favours certainty in their judgement of possibilities. Hence, it is only natural to presume that (Q) is resting on processes and changes that are significant for competition. All participants have been successful in accommodation and produced appropriate perceptual discriminations within the limits controlling the development of Eigenvalue.

The proportions of variance, related to "Visibility of Social Texture" of Figure 12, make evident that the reaction pattern, resting on certainty in perceived "Visibility of Social Texture", are co-varying with success, however in a negligible way.

Figure 12.

Combined Rotations on the Basis of the Principal Component (FII)



The corresponding perpendicular Y-axis of the "Visibility of Social Texture" shows that the moment of inertia decreases as the rotation axis gets closer to the "textured surface". This is clear from the smaller values of the longitudinal Z-axis: [A: $I_{yy} = 0.00$; B: $I_{yy} = 0.03$; C: $I_{yy} = 0.13$].

Concerning "Success"-vector, only about 3% of systematic variance can be related to the condition of flexibility. Moreover, the "Competition"-vector has no effect. Like the supporting substance of a floor, i. e., the shallow side of a "cliff", social texture is associated with zero variability. Hence, a change in relative position vis-à-vis the "cliff" implies a step-by-step advancement on a firm or unmoving surface toward depth and the danger of "falling". In interpreting the corresponding effect from a societal point of view, due to the negligible effect (3%), it can be stated that the participant is aware of a rigid social texture. A "societal hard cover" appears as non-varying space for competition.

Again, the “Context”-vector accounts for a mediocre amount of extracted variance (about 13%). Purely artificial classification in Danish and Swedish cities due to historic circumstances of war makes no difference in certainty and differentiation of judgement. When all other components are held constant, it means that the Sound as a region provides for the same kind of societal development. Over centuries, the environmental conditions of richness of natural resources have produced the same kind of civilisation as manifested in the response tendencies on both sides. However, with reference to the Singaporean participants, the effect only points toward further accentuation of their “style of response”.

When the participants from Singapore are compared with the participant of the other two cities, it becomes obvious that the response pattern of the Singaporean participants shows the general tendency of a higher degree of “certainty” in judgement independent of what is judged. Since this effect must be considered as illustration of the “scale-effect”, it can be concluded that the atmospheric pressure of all three participating cities has induced the same dynamics into its citizen’s perceptual system of discrimination. From the experimental point of view, it can be stated that the participants of these cities are indistinguishable. Hence, these cities must have some parts of structure in common, and as a result of this commonality, must be counted alike (Rosen, 1978).

From the point of view of measurement, the property (Q) of a particular present-day civilisation may be the result of the atmosphere that has differently developed in the participating cities. For example, if (Q) has been defined in terms of pressure to achieve, then conserved atmospheric pressure would be a measure on the visibility of achieved developmental progress. However, if (Q) would have been the result of an atmosphere in which the pressure to achieve is absent, this measure would be an expression of a non-demanding, and hence non-competitive civilisation. In any case, certainty in the presence of (Q) is an objective indication of the degree of competitiveness in these cities. This is so because the presence or absence of the pressure to compete would continue to exist even though the criterion for its measurement (Q) has been removed. Hence, the more specific research question to be answered has present day actuality and concerns all three cities, namely their capacity to promote the development of perceptual competence.

Discussion

In general, the “lens model” has been a very productive metaphor, which has been guiding classical reasoning in the natural sciences over centuries. Particularly, its fortune in optical manifestation, associated with successful mathematical modelling, has made it possible for the scientists in physics to discover the “true” nature of the “macro-world” and for scientists in biology to get a deeper understanding of the “micro-world”. Therefore, it is only natural to expect that the lens model would also be productive within the areas of psychology. Consequently, Slovic and Lichtenstein (1971, p. 649) noticed that the lens model has “proved to be an extremely valuable framework for conceptualising the judgement process”. Hence, this model is expected to provide a means for the study of “real” consciousness and detached from confounding contextual factors.

At least two lines of approach can be discerned. One takes its departure in Brunswik (1969, p. 20), who takes the model as “composite picture of the functional unit of behaviour”. He concentrates on the scheme of congruent light rays, when passing through a convex lens. As model for “apparent purposiveness” it is taken as a manifestation of “value constancy”. Both parts of Brunswik’s model are related to each other in a symmetric fashion and require the measurement of probabilities of change within components. Probabilistic descriptions have been provided with the help of multiple correlation (r) and regression statistics. In short, in Brunswik's model (r_e) is proposed to reflect perceived variations in an environment, while (r_s) is reserved for the representation of variations within the subject of measurement. Hence Brunswik's point of departure lies in his ambition to achieve a description of the relation between "rays" and the environmental variable on one hand and between "rays" and the response system of the subject on the other hand. Since his emphasis is on the correlational relationship between individual and environment, he developed a certain kind of "lens model" in order to represent organism specific and environment specific components as inter-correlation.

Further, Brunswik's approach has been expanded due to Hursch, Hammond, and Hursch (1964). Their elaboration concerns the expression of non-linear cue utilisation. This property has been made manifest in the "C-coefficient", which gives expression to the correlation between various residuals. Moreover, Tucker (1964) has shown that the indices of the model can be expressed by means of a general equation, which has come to be called the 'lens model equation'.

In contrast, Sommerhoff (1950) has taken a non-probabilistic approach. Hence, the fundamental difference of his modelling lies in the emphasis on events occurring between components. It follows that Sommerhoff's lens model is designed on the premise of the need for a variable (his coenetic variable) that captures directiveness and consequently the transitions between components as well as phases. At the centre of Sommerhoff's approach lies the characterisation of "directiveness of life processes and biological organisation" as stated in the monograph on analytical biology (Sommerhoff, 1950, p. v). For example, in identifying exactly the meaning of co-variation and inter-action, his modelling has been of enormous help to the present approach. It has made it possible to provide the concept of "co-ordination" with rigorously defined limits. In this respect, Sommerhoff's lens model has to be conceived of as a fundamental part of the presented construction of a "Success-Competition" mechanism for the study of perceptual competence.

Measuring perceptual competence means that there is a variance component for each condition. It follows that a definite criterion for its proper functioning has been provided. This criterion concerns the difference in the directiveness of the relationship between (CV) and (FC) and of the "rotation" mechanism in the form of certain projections that accounts for the "degree of convexity" of co-ordinated lines of behaviour, representing the formed response surfaces. As inferred throughout the present report, the "(C–S)-mechanism" is made up of measurable variables, which concern its flexibility. It has been shown that flexibility accounts for about 37% of explainable variance. The demonstrated functioning of the mechanism makes evident that each possible value of either (CV) or (FC) must form the origin of a line of perceptual behaviour, which starts in (CV) and intersects (FC) in a unique fashion. Otherwise, no perceptual competence is demonstrable. Thus, when time is entering the process, it is possible to show that the functioning of the mechanism is associated with the absence of a "diffraction error" (i. e. divergence in the lines of behaviour).

In testing the adequacy of the lens-assumption, it is sufficient to imagine a convexity of zero degree. When this is the case, asymmetry has disappeared and judgement on perceptual competence must be suspended. However, in the presence of asymmetry, a judgement on the precision in perceived life quality is possible and gives, by definition, an indication of the achieved level of perceptual competence.

The presented behavioural foundation of competence is the result of the effects of direct perception in a demanding societal environment and the demonstration of the single individual's ability of immediately "standing the trial". Based on the first order differential equation, mastering momentarily the rates of change in important features of projected civilisations has resulted both in numerical specification of the rates of change as well as the observed patterns. An analysis of achieved levels of competence is fundamental for the survival of any individual as well as any civilisation; anyone, who must make a living in a particular society should make intentional use of the outcome of the values integrated with the perceptual functions. These functions are the foundation for sustaining life quality and should be of concern both for the single citizen as well as for the civilisation in which he is expected to make a living.

The cities of Lund in the South of Sweden, Copenhagen in Denmark, and Singapore in the South of East Asia have been chosen for a description of possible differences concerning the indications of perceptual competence. By means of an experimental and multivariate procedure as well as by means of the established criterion, it has been demonstrated that Singapore in the eyes of the Singaporean participants has been developed toward the specified goal: "Towards A Tropical City of Excellence". Based on the results of the present study, this goal means "competition" and it has been explicitly expressed on the Visiting Card of one of its Executive Planners in the City's Urban Redevelopment Authority.

If competing for "excellence" means the attainment of the standards of Northern Europe, the presented approach has demonstrated that Singapore is on the same level. This conclusion can be drawn, because it has been assumed that consistency in a response pattern is associated with "certainty" in sensing of a certain degree of life quality. It is therefore only natural to expect "certainty" as expression of perceptual clarity. It follows that certainty is a function of extracted or abstracted ecological invariants. In this sense, perceptual clarity is synthetic. Since very restricted limits have governed this analysis as well as the derived conclusion, sameness in developed competence can be concluded.

Basically, this "Competition-Success" mechanism has allowed the control of perceptual transitions between the components of projection within rigorously defined limits. The latter implies that flexibility in competition must be conceived of as the fundamental condition for societal progress. The constructed mechanism has provided a means for making "sense", that is sensing "real" competence. Striving for excellence or competition has been detached successfully from confounding contextual factors, since the setting factor only accounts for about 5% to 13% of common variance.

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